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On the Nature of Transitions: the Middle to Upper Palaeolithic and the Neolithic Revolution

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This article discusses two major revolutions in the history of humankind, namely, the Neolithic and the Middle to Upper Palaeolithic revolutions. The course of the first one is used as a general analogy to study the second, and the older one. This approach puts aside the issue of biological differences among the human fossils, and concentrates solely on the cultural and technological innovations. It also demonstrates that issues that are commonplace to the study of the transition from foraging to cultivation and animal husbandry can be employed as an overarching model for the study of the transition from the Middle to the Upper Palaeolithic. The advantage of this approach is that it focuses on the core areas where each of these revolutions began, the ensuing dispersals and their geographic contexts.

Revolutions occur from time to time during the evolution of humankind. Although scholars disagree on the number of recognizable major cultural changes that merit the label 'revolution', there is hardly any doubt that both the transition from the Middle to the Upper Palaeolithic and the transition from foraging to agriculture should be included.

Several years ago I suggested that the models available for the agricultural or Neolithic revolution might assist us in building models and seeking information about the Middle to Upper Palaeolithic revolution (Bar-Yosef 1992; 1994). Current knowledge of the processes involved in the Neolithic Revolution brings major advantages when we examine other dramatic changes which occurred some 50,000 to 40,000 years earlier. First, the Neolithic Revolution was the achievement of a single human species, namely our own *Homo sapiens*. Second, archaeological knowledge of this revolution indicates a direct relationship between the Near East and Europe. Third, the large body of data on the transition to agriculture, collected from a single well-defined geographic region, clearly demonstrates temporal and spatial trajectories.

As with the agricultural revolution, several generalizations concerning relatively rapid cultural changes and long-range movements of populations can be made on the Middle to Upper Palaeolithic revolution. In my view, what has hampered a better understanding of this earlier revolution is the fact that most scholars have presented their hypotheses from a West European perspective. It would be advantageous to look at the same problem from a Near Eastern viewpoint, without of course endorsing the automatic assumption of *ex oriente lux*.

For the purpose of clarity I will move through time from the recent to the more remote past. After all, one can only excavate a site from the recent surface to the bedrock and not the other way around. Adopting such a trajectory is not much different from the way we build our models: by using analogies derived from the recent historical past, from fields such as ethnohistory and ethnoarchaeology, and by testing our assumptions through actualistic studies, we try to overcome the epistemological obstacles.

The discipline of archaeology is used to reconstruct cultural history or to test functional-adaptational models. Archaeologists employ or borrow from the research methods and results of other disciplines in order to make sense of our finds in the field and in the laboratory. Thus knowledge of social behaviour is derived from the works of social anthropologists, sociologists, and primatologists.

Bioanthropologists, whether concerned with fossils or living populations, provide us with the essential building blocks for reconstructing past demographies and phylogenetic relationships. Linguists and brain scientists produce information and models concerning language development and cognition. Geneticists and linguists challenge our interpretations of past societies, migrations, and boundaries between social entities. Other scientists supply information on the preservation of archaeological remains, the sourcing of materials, site formation processes, past climates, vegetations and faunas. Radiometric dates are certainly produced from samples we may collect ourselves, but only by specialists who work in different laboratories. It is indeed becoming virtually impossible to integrate the variable archaeological data sets into a coherent picture without working closely with a large group of other scholars. The days of the pioneer archaeologist, the individual with total reponsibility for the entire archaeological operation, are gone.

The ultimate goal of such all-encompassing archaeological projects is to tell some particular story about why, where, and when human societies changed. In the process we look for answers to questions such as how and why societies differed from each other in their structure and organization, subsistence strategies, perception of the landscape, and cultural constructs such as cosmology and/or religion. It is no less important to find out why certain people and their cultural patterns survived through good and bad times while others vanished. History is littered with stories of winners and losers, and the changes brought about by the two revolutions considered here exemplify this fate.

Prehistoric revolutions

Past revolutions are always evaluated on the basis of their outcome. Gradualists see even the most dramatic cultural and socio-economic transition as a slow process that took hundreds or even thousands of years to be completed. In contrast, those who view the change as radical and rapid try to find out when and where it began. The successful completion of the first phase of a crucial transition culminates in the reaching of 'a point of no return'. Once the major catalytic change or changes occur, a new socio-economic system emerges. Hence, even if the results became clear in the material world only a century or more later, this process is still considered a 'revolution'. This is the position employed in the following pages.

In historical studies one can trace and date the generation when such a revolution began. For instance, historical documents and archaeological remains reveal exactly when and where the Industrial Revolution in eighteenth-century England took place, how quickly technical inventions were transported to other regions, when and how social changes occurred, etc. (e.g. Landes 1969; Hartwell 1971; Wolf 1982; Braudel 1987). Finding an overall agreement among historians and anthropologists concerning the 'why' question is more difficult (e.g. see papers in O'Brien & Quinault 1993). The lesson from the investigation of the recent past is that the 'when' and 'where' are relatively easy to identify and date, but 'why' answers remain elusive and open to constant re-interpretations.

It is somewhat difficult to figure out the when and where of a prehistoric cultural transition such as the Neolithic Revolution. Here the time scale is based on radiocarbon dates, with their stated margins of error, rather than historical data. Furthermore, even with the new calibration curves, we still cannot expect to achieve greater accuracy in dating than within a few centuries (e.g. Evin 1995; however, note that all the dates in this paper are uncalibrated BP).

For the purpose of the following discussion I have borrowed the notions of core and periphery from the Industrial Revolution (as already elsewhere; see Bar-Yosef & Belfer-Cohen 1989a). These terms will be used only in the geographical sense with reference to rudimentary socio-economic variables such as subsistence strategy, time and energy budgets, level of female fertility, social entities and so forth. There were also peripheries within the core area during the Industrial Revolution, which meant that inventions and innovations as well as power and richness were not evenly distributed throughout an expansive region but were more locally concentrated. As I will briefly show below, this model is useful in examining the Neolithic Revolution in Southwest Asia.

Introduction to the agricultural revolution

The Fertile Crescent in the Near East, or more appropriately southwest Asia, is one of the two oldest centres of agricultural revolution in the Old World (the other being the middle Yangzi River in China, cf. Smith 1995; Fig. 1). Archaeological evidence, including botanical determinations of carbonized plant remains, is rapidly accumulating (e.g. Harris & Hillman 1989; Hillman 1996; Kislev 1997). There is little doubt today that systematic cultivation of

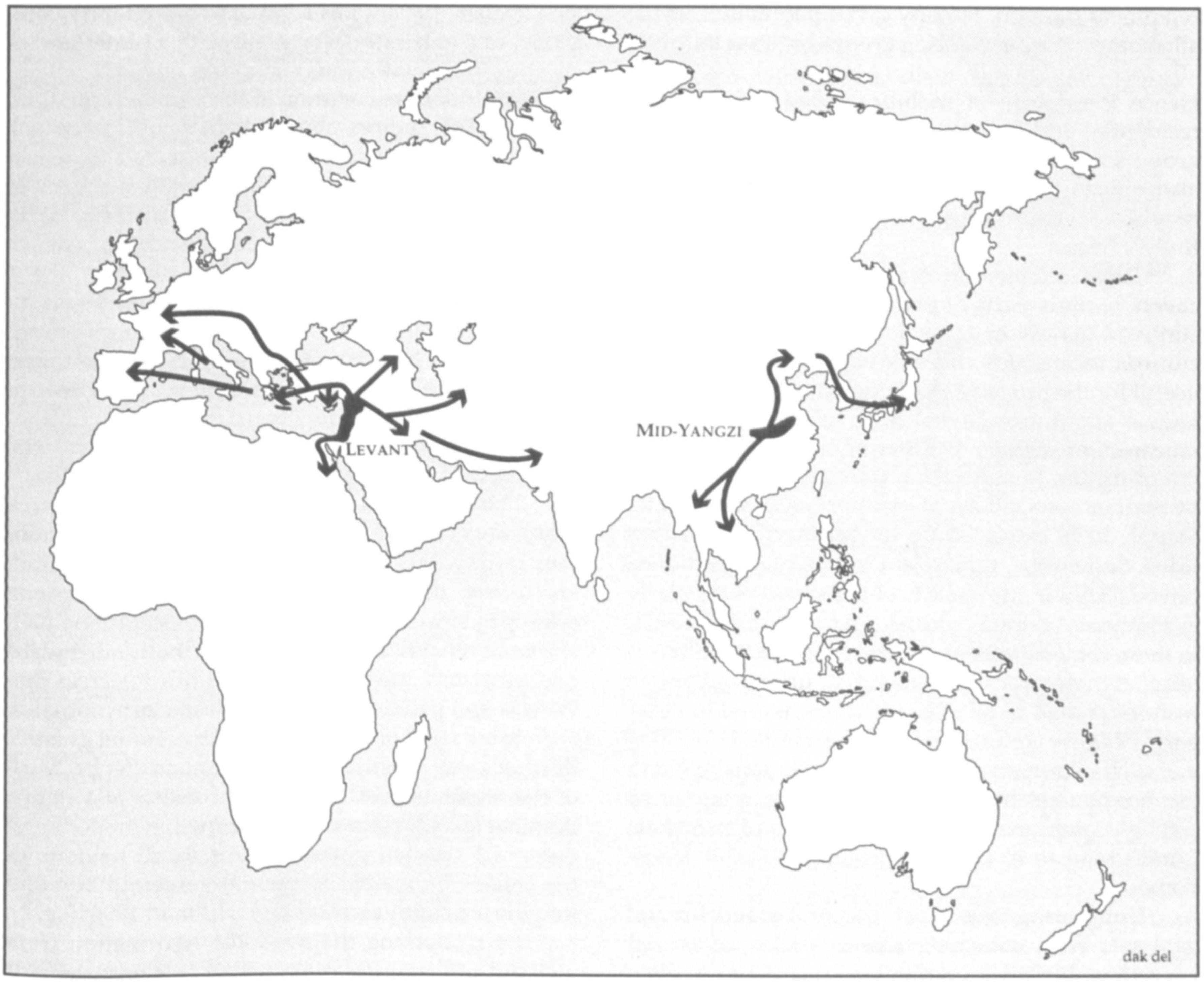

Figure 1. *The centres of early agriculture in the Old World and possible routes of dispersals.*

cereals and other 'founder crops' resulted in their domestication after several centuries (Hillman & Davies 1990; 1992; Miller 1992; Zohary & Hopf 1994; Bar-Yosef & Meadow 1995). This was followed by the domestication of goat and sheep, with the later additions of cattle and pigs (Flannery 1983; Smith 1995; Legge 1996). Hence the main transition to cultivation was made by hunters-gatherers. Once they became cultivators, even if that was only a part-time activity, social, technical and economic changes must naturally follow. We therefore need to examine carefully, from the archaeological evidence, how foragers shifted their subsistence base in a world that had not yet accommodated farmers elsewhere. We need to examine the region at the time when it was still inhabited by foragers. As is often the case, a summary of the archaeological record requires a general understanding of the principles underlying the hunting and gathering ways of life on which we base our interpretations.

The ethnographic literature on hunter-gatherers was written mainly during the nineteenth and twentieth centuries, although reports by early European travellers (sixteenth to eighteenth centuries) are also known. On the whole, the information gathered indicates that the degree of mobility of a group depends on what may be referred to as the 'costs and benefits' of foraging. In turn, these factors are directly affected by the nature, distribution, predictability, reliability, and accessibility of resources, which together determine the carrying capacity of a given territory (Binford 1980; 1983; Kelly 1995 and references therein). For any given population, social alliances with neighbouring groups increase the overall size of exploitable territory in seasons of scarcity. Hence the nature of mobility (often a mixture of residential and logistical moves) affects the overall group size and/or its mating system, and therefore also affects the optimal size of territory which is required to ensure long-term biological survival (e.g. Kelly 1995).

The available information on hunter-gatherers covers various parts of the world. As foragers have survived mainly in zones unsuitable for early agricultural techniques and cultivated crops, it is most useful for the purpose of analogy to consider what is known about groups that have inhabited 'Mediterranean-type' regions. The area of the Near East where the transition to cultivation took place was covered by various associations of Mediterranean vegetation. Steppic belts extended on its northern and eastern sides. Somewhat similar environmental conditions can be found in other parts of the world particularly in southern Australia, southern Africa and California. In these regions, where a certain kind of 'Mediterranean' climate prevails, densities of hunter-gatherers were estimated to be rather high compared to other parts of those continents (e.g. Lourandos 1997). Under such circumstances, both the relationships and the boundaries between groups were maintained through communal feasts, ceremonies and exchange. Conflicts arose in cases of prolonged stress conditions.

Combining the most recent palaeoclimatic data sets with information from pollen cores and zooarchaeological investigations, we may simulate the potential exploitation patterns that foragers in the Near East could have practised during most of the Upper Pleistocene. The reconstructed or simulated settlement patterns can then be tested against the available archaeological records for the Middle and Upper Palaeolithic and for the Epi-Palaeolithic and Neolithic periods. This approach indicates the fields and areas where further research is urgently needed.

Foraging settlement patterns in the Near East

The Near East (see Fig. 2) includes Anatolia, the Zagros mountains and Mesopotamia, the Levant, the Syro-Arabian desert and the Sinai peninsula. Most of the archaeological remains relevant here are located on the Anatolian plateau, or the foothills of the Taurus and Zagros mountains, and in the Levant.

The Mediterranean belt along the Turkish shoreline and the Levant has a variable topography composed of a narrow coastal plain with a hinterland of more or less continuous mountain and hill ranges. High altitudes are common in the Taurus ranges (up to 3500–4000 metres above mean sea level) which descend northward into the Anatolian plateau, where the average elevation is 1000–1500 metres a.m.s.l. In the Levant the Rift Valley separates the hilly backbone from the eastern mountains and hills, which slope into the Syro-Arabian desertic plateau.

The region is characterized by marked seasonality: winters are cold and rainy while summers are hot and dry. Topography, soils and climate determine the dominant vegetational belts. The description here follows the recent reconstruction of phytogeographical belts in the Terminal Pleistocene proposed by Hillman (1996).

Hillman defines three major belts. The area along the coastal plains and the first hill and mountain ranges was covered by forest and woodland, including montane forest, eu-Mediterrannean sclerophylous woodland and xerix deciduous oak-Rosaceae woodland. The next belt, both northward and eastward, was the oak-terebinth (*Quercus* sp.-*Pistacia* sp.) park-woodland, a mosaic of woodland, with more open areas dominated by annual grasses. Further away was the terebinth-almond steppe. Most of the region beyond these belts consists of a steppe dominated by wormwoods, perennial chenopods and perennial tussock grasses. The natural habitats of the cereals lie mainly in the oak-terebinth belt and into the terebinth-almond belt (Hillman 1996; Fig. 2).

By combining the available information from wetland pollen cores, wood charcoals and remains of food plants (e.g. van Zeist & Bakker-Herres 1986; van Zeist 1986; Baruch & Bottema 1991; van Zeist & Bottema 1991; Miller 1992; Baruch 1994), Hillman was able to reconstruct the dynamic vegetational expansion from 13,000 BP to 11,000 BP, though he did not offer a similar reconstruction of the situation during the succeeding Younger Dryas stage. According to the archaeological evidence, the earliest cultivating communities appear during the closing centuries of the latter period.

Various sources of information demonstrate that the climate of the region during the Upper Pleistocene and Early Holocene was essentially similar to that of today. These sources include pollen cores from Turkey and Iran (van Zeist & Bottema 1991), chemical analysis of the beds of the Upper Pleistocene Lake Lisan in the Jordan Valley (Begin *et al.* 1985), and the early Holocene distribution of C3 and C4 plants in the Negev (Goodfriend 1991). Decadal and centennial

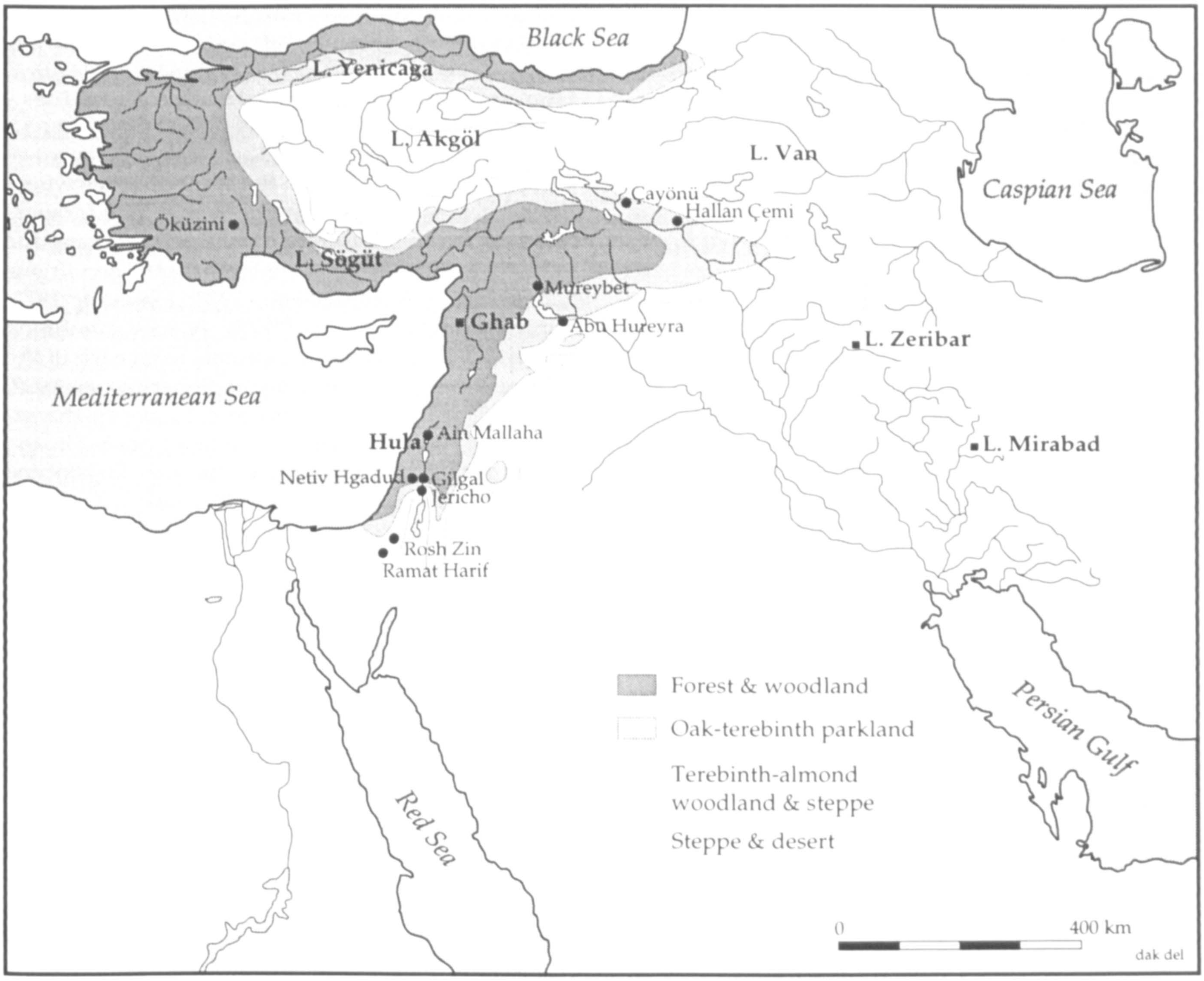

Figure 2. *A reconstructed vegetation map (after Hillman 1996) for the period following cold phase of Isotope Stage 2 (13–11 ka* BP*) with the location of several Natufian and early Neolithic sites.*

fluctuations of precipitation, more than temperature changes, were responsible for the expansion and contraction of the vegetational belts as reflected in Hillman's reconstructions (Hillman 1996).

Floral food resources in the region are seasonal, with seeds most abundant from April to June and fruits from September to November. Edible tubers, bulbs and roots are rare (Danin 1983; Shmida *et al.* 1986). The Mediterranean belt is the richest area, as one might expect, with over a hundred species of edible fruits, seeds, leaves, roots and tubers.

The faunal biomass was probably high in the woodland-parkland environments and gradually dwindled away into the steppic belt. Game animals included the mountain gazelle (*Gazella gazella*), a non-migratory antelope with a small home range that varies from a few to as many as 25 square kilometres. A similar pattern, perhaps with a larger home range, can be inferred for *Gazella subgutturosa*, the dominant species in the Syro-Arabian desert. Other mammals included wild cattle (*Bos primigenius*) which were more common in Anatolia than in the Levant. Deer (*Dama mesopotamica* and *Dama dama* in Anatolia), roe deer (*Capreolus capreolus*), and wild boar (*Sus scrofa*) were abundant in the forest-woodland belts. Wild goat (*Capra aegagrus*) occupied parkland and hilly areas and was common in the Taurus and Zagros, while the ibex (*Capra ibex*) inhabited the steep, drier landscapes in the Levant. Finally, the wild sheep (*Ovis aries*) was present mainly in Anatolia and the Taurus-Zagros foothills (Uerpmann 1987; 1996; Smith 1995).

Once we determine whether Upper Pleistocene hunter-gatherers inhabited a vegetational belt or an ecotone at a given period, we can begin to reconstruct patterns of optimal foraging. The varied topography made seasonal movements easy, with winters spent in lowlands and summers in the highlands. The main food resources and higher animal biomass were located in the ecotone of the forest and oak-terebinth parkland. Thus harvesting wild cereals could have fallen to special task groups, or have involved short-term general residential moves into the oak-terebinth/terebinth-almond (*Quercus* sp.-*Pistacia* sp. or *Pistacia* sp.-*Amiggdalus*) ecotones.

The optimum territory for a band of hunter-gatherers in the woodland-parkland belt is estimated at about 300–500 square kilometres. In contrast, foragers in the steppic and/or desertic region would have needed a larger area, perhaps 500–2000 square kilometres, in order to maintain a sufficient buffer against annual fluctuations (Bar-Yosef & Belfer-Cohen 1992). The former could have been semi-sedentary while the latter would have been forced to move their camps more frequently.

Under this regime, decreasing annual precipitation and shifts in the distribution of rains, causing diminishing yields of wild fruits, seeds and game animals, would create situations of stress mainly in the steppe and desert belts. By contrast, resources in the Mediterranean belt would have remained more stable.

Food shortages, either long- or short-term, could have been alleviated by hunter-gatherers in the following ways (Bar-Yosef & Belfer-Cohen 1991): (1) population aggregation in the Mediterranean core areas; (2) techno-economic reorganization, such as allowing increased returns from the same wild stands, coupled with re-scheduling of hunting trips within the same territories; (3) migration to neighbouring areas, northward or southward (in the Levant) or along the coastal ranges. Groups that opted to move or migrate faced three options when encountering the 'others'. They could avoid or ignore them, form an amicable relationship (that would often lead to interbreeding) or confront them as rivals. Warfare among hunter-gatherers, as an alternative social solution for inter-group competition, is well-known (Keeley 1996).

Each of these strategies would have led to the emergence of a new settlement pattern, different social alliances and possibly adjusted ideologies. Thus, substantial environmental change, whether improvement or deterioration, would result in important spatial reorganization of populations, and sometimes in significant social development. The identification of such events in the archaeological record is of great interest.

From sedentary foragers to farming communities

Hypotheses have placed the earliest occurrences of crop cultivation either in the natural zone where cereals grow or in the marginal belt where foragers faced decreasing returns of plant food resources due to substantially worsening environmental conditions (Childe 1952; Binford 1968; 1983; Flannery 1973; Braidwood 1975; Cohen 1977). A new combined model would incorporate elements from each of the previous ones (e.g. Bar-Yosef & Belfer-Cohen 1992; Smith 1995; Hole 1996). In order to clarify the sequence of cultural changes we need to begin the survey with a brief comment on the Late Pleistocene foraging societies.

The archaeology of the Late Palaeolithic foragers in the central and southern Levant is well-known, whereas much less information is available about this period in northern Syria and Turkey (Bar-Yosef & Meadow 1995 and references therein). Sites of the Kebaran complex (*c.* 18,000–14,500 BP) were limited to the coastal Levant and isolated oases by the prevailing cold and dry climate of the Late Glacial Maximum. Foragers of the succeeding Geometric Kebaran took advantage of the climatic amelioration around 14,500–13,000 BP to expand into the formerly desertic belt, which had become a lusher steppe. Common game animals throughout this period included deer, wild goat and sheep in the Taurus (Otte *et al.* 1995), deer, gazelle and wild boar in the central Levant, and gazelle, ibex and hare in the steppic belt. Portable groundstone mortars and bowls, which first appeared during the Upper Palaeolithic, *c.* 29–27,000 BP in Qafzeh and Shanidar as well as bedrock cupholes, are considered to indicate vegetal food processing (Wright 1991). These utensils are found in Kebaran, Geometric Kebaran and other contemporary archaeological entities in both Mediterranean and steppic sites. Actual evidence for the consumption of plant food has been recovered from the waterlogged site of Ohallo II (in Lake Kinneret, Israel) and dated to 19,000 BP by an extensive series of radiocarbon readings (Kislev *et al.* 1992; Nadel *et al.* 1995). The suite of gathered and collected fruits and seeds there include abundant cereals, indicating that this staple food was already a major component in the human diet. A similar though broader spectrum of gathered plant foods is known from the more northerly area in the later Epi-Palaeolithic layer at Abu Hureyra, dated to *c.* 11,500–10,500 BP (Hillman *et al.* 1989).

The re-colonization of the steppic-desertic belt can probably be directly attributed to climatic improvement around 14,500 BP. Human groups moved or expanded from the Mediterranean woodland-parkland into previously uninhabited areas. Other groups may have come from the Nile valley (Henry 1989; Bar-Yosef & Belfer-Cohen 1992). This period terminates with an important socio-economic threshold marked by the emergence of the Natufian culture (e.g. Bar-Yosef 1998 and references therein).

The appearance of the Natufian is the culmination of various tactical and strategic adaptations that Levantine hunter-gatherers had to make around 13,000 BP. There is currently no agreement on exactly why this culture developed. On the one hand, climatic improvements around 13,000 BP provided a wealth of food resources (Hillman 1996). On the other hand, population growth in both the steppic and desertic region *c.* 14,500–13,000 BP made any abrupt, short-term, climatic fluctuation an impetus for human groups to try to establish realistic control over their territories. What we actually see is the establishment of a series of sedentary Early Natufian hamlets in a delineated 'homeland' (Fig. 3) that would resemble the ethnographically known settlements of the northwest coast Native Americans. This major shift can be interpreted as a reaction to an abrupt environmental change (the Older Dryas?) that necessitated a new approach to the way resources were exploited. It is not inconceivable that previous patterns of semi-sedentism among Late Pleistocene foragers, mentioned above, were simply replaced by firmer tenure over certain territories. Some researchers argue that sedentism was mainly a response to the need to intensify cereal exploitation (e.g. Henry 1989; Bar-Yosef & Meadow 1995). Others suggest that sedentism came first, and increased the propagation of annuals such as cereals (McCorriston & Hole 1991).

Elements and steps of the Neolithic revolution

The search for the earliest farming communities began in earnest with R. Braidwood's pioneering project (Braidwood & Howe 1960; Braidwood *et al.* 1983) in the hilly flanks of the Zagros and later in the Taurus. In his view, early farming sites were located in the natural habitats where the wild progenitors of various species of cereals grow today. His approach was supported by botanical surveys across Western Asia (Harlan & Zohary 1966; Harlan 1977). Unfortunately, the impact of Late Pleistocene–Early Holocene climatic changes on this region were not taken into account (Wright 1995), not even in the updated summary of the domestication of the Near Eastern crops (Zohary & Hopf 1994). If these environmental shifts are given due weight as factors influencing the cultural sequence, an interesting picture emerges. As a first step towards employing the lessons learned from research concerning this Neolithic revolution in a study of the much older Middle/Upper Paleolithic revolution, I will briefly summarize the relevant evidence (Hole 1984a; Bar-Yosef & Belfer-Cohen 1989a; 1992; Bar-Yosef & Meadow 1995; Hillman *et al.* 1989; Hillman 1996; Legge 1996; Garrard *et al.* 1996; Sherratt 1997; van Andel & Runnels 1995; Smith 1995):

1. The 'Neolithic revolution' was achieved by, and affected, a single human species, namely *Homo sapiens* and does not coincide with any biological change. However, the shifts in diet, food preparation techniques, domestication of goat, sheep and later cattle, as well as living conditions, resulted in major impacts on human body size, health and ability to digest dairy products (Cohen 1989; Durham 1990).
2. Despite certain ambiguities concerning the interpretation of terrestrial pollen data (Rossignol-Strick 1995), there is general agreement that the Younger Dryas climatic event is documented in East Mediterranean marine and lake cores. While the dating of pollen cores can be upset by the effects of hard water (Wright 1995), a reliable chronological estimate can be obtained by counting laminated sediments (e.g. Landmann *et al.* 1996).

The climatic crisis of the Younger Dryas (*c.* 11,000–10,000 BP), which actually lasted about 1300±70 calendrical years (Mayewski & Bender 1995), resulted in major environmental deterioration which undoubtedly affected the subsistence strategies of the Natufian population. One of the main outcomes of the cold and dry conditions of this period may have been a decrease in the natural production of C3 plants such as cereals. In addition, previous exploitation of the environment by sedentary Early Natufian communities as well as by neighbouring foragers, would have exacerbated the depletion of plant and animal resources (Tchernov 1991).

Social reactions to the worsening environmental conditions varied in different regions of the Near East. One example is the well-documented case of the Harifian culture, *c.* 10,700–10,100 BP (Goring-Morris 1991). In the Negev and northern Sinai, the Late Natufian groups improved their hunting techniques through the invention of the Harif point, a more efficient projectile point. Bone

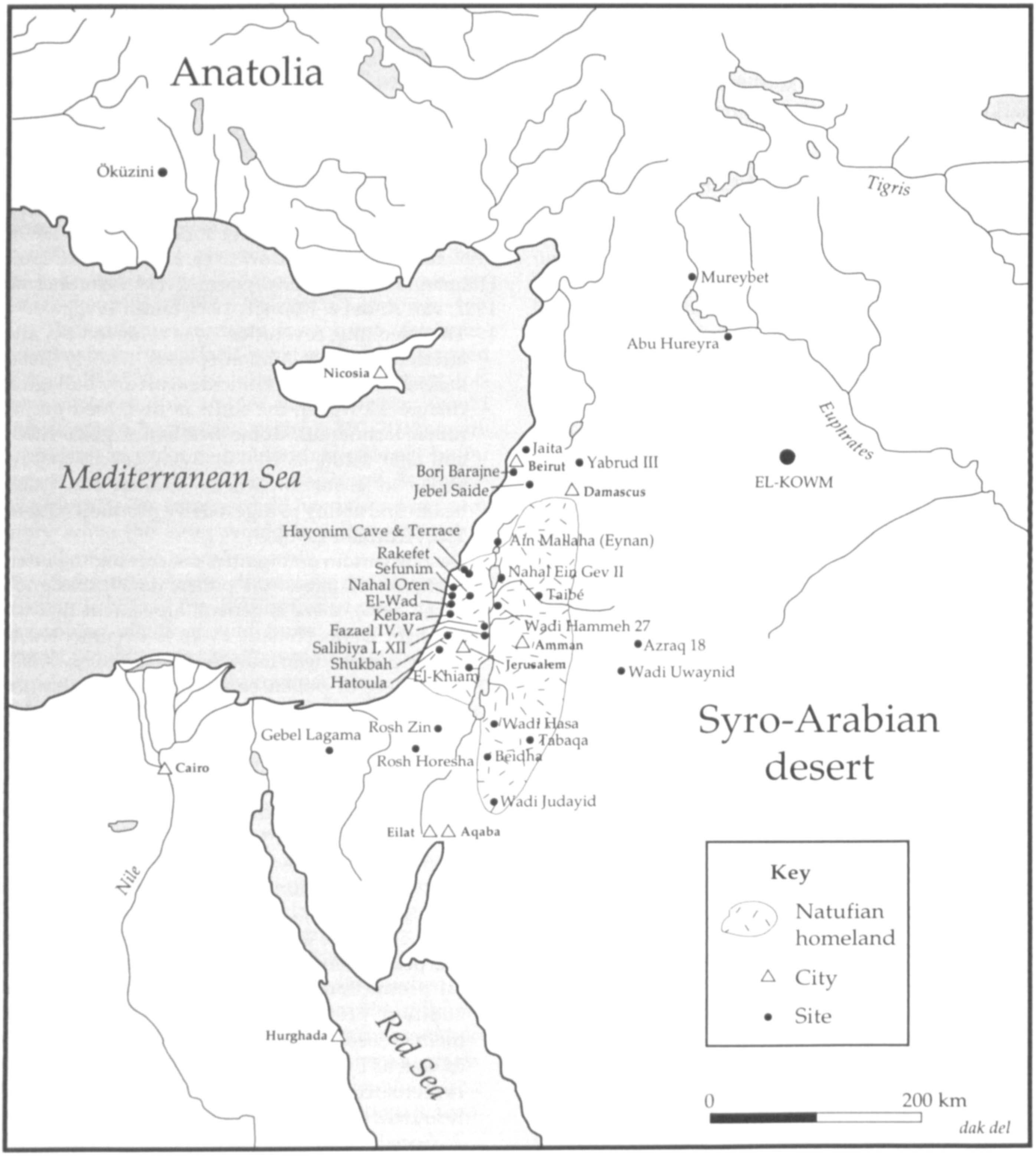

Figure 3. *The Natufian 'homeland'.*

remains at Harifian sites indicate hunting of local fauna (gazelle, ibex, hare and perhaps wild sheep), while grinding stones, mortars and cup-holes indicate the processing of undetermined plant food elements. Large collections of marine shells demonstrate abundant contacts with both the Red

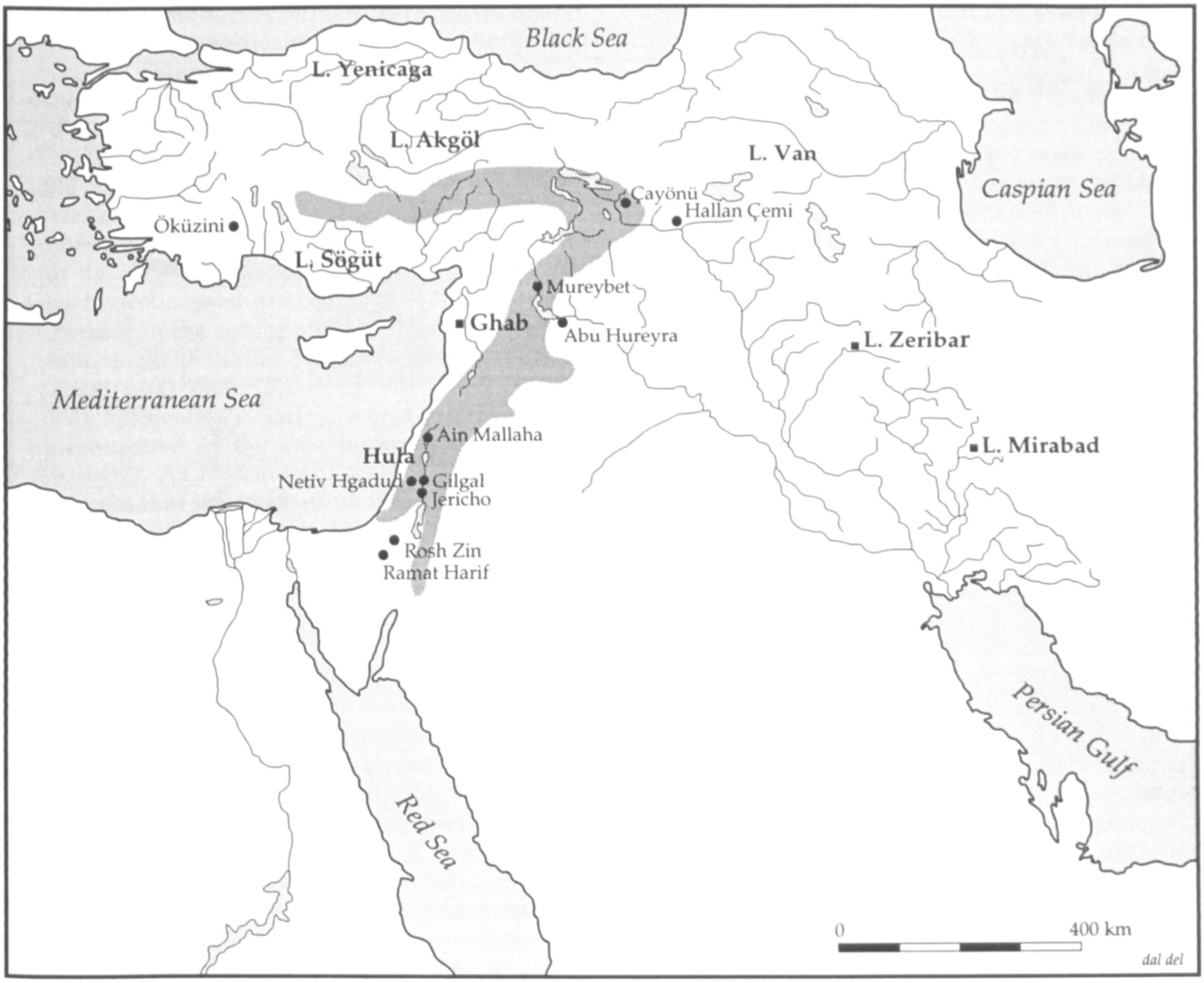

Figure 4. *The distribution of extensive stands of wild cereal during the Younger Dryas. (Modified from Hillman 1996.)*

Sea and Mediterranean shores (D.E. Bar-Yosef 1991). The overall territory of the Harifian, as estimated from surveys, is at least 8000 km^2, and could have been up to 30,000–50,000 km^2. Radiocarbon dates on wood charcoal allow us to estimate that the total duration of the Harifian was only two to three hundred years, clearly an unsuccessful attempt to adapt to increasing aridity. Intensive surveys show that this territory, when finally abandoned, remained essentially uninhabited for about one thousand radiocarbon years.

3. Palaeobotanical reconstruction of the Younger Dryas indicates that the progenitors of most cereal species grew in a relatively narrow strip of the Levant (Fig. 4). The archaeological record shows that the first communities of cultivators appeared in this area, and it seems that this was the locus for the emergence of agriculture in Western Asia. The rapidly increasing CO_2 levels of the early Holocene provided suitable conditions for the continuous successful cultivation of C3 plants (Sage 1995). Hence early cultivating communities, known in the Levant as Pre-Pottery Neolithic A (PPNA, *c.* 10,300–9600/9300 BP), flourished after the end of the Younger Dryas within the Levantine Corridor (Bar-Yosef & Belfer-Cohen 1989a; Cauvin 1994; Fig. 5). Population growth in early villages, resulting from increasing sedentism, led to active emigration (Ammerman & Cavalli-Sforza 1984; van Andel & Runnels 1995). The process of establishing new communities was in turn facilitated by the wetter and increasingly warmer climate of

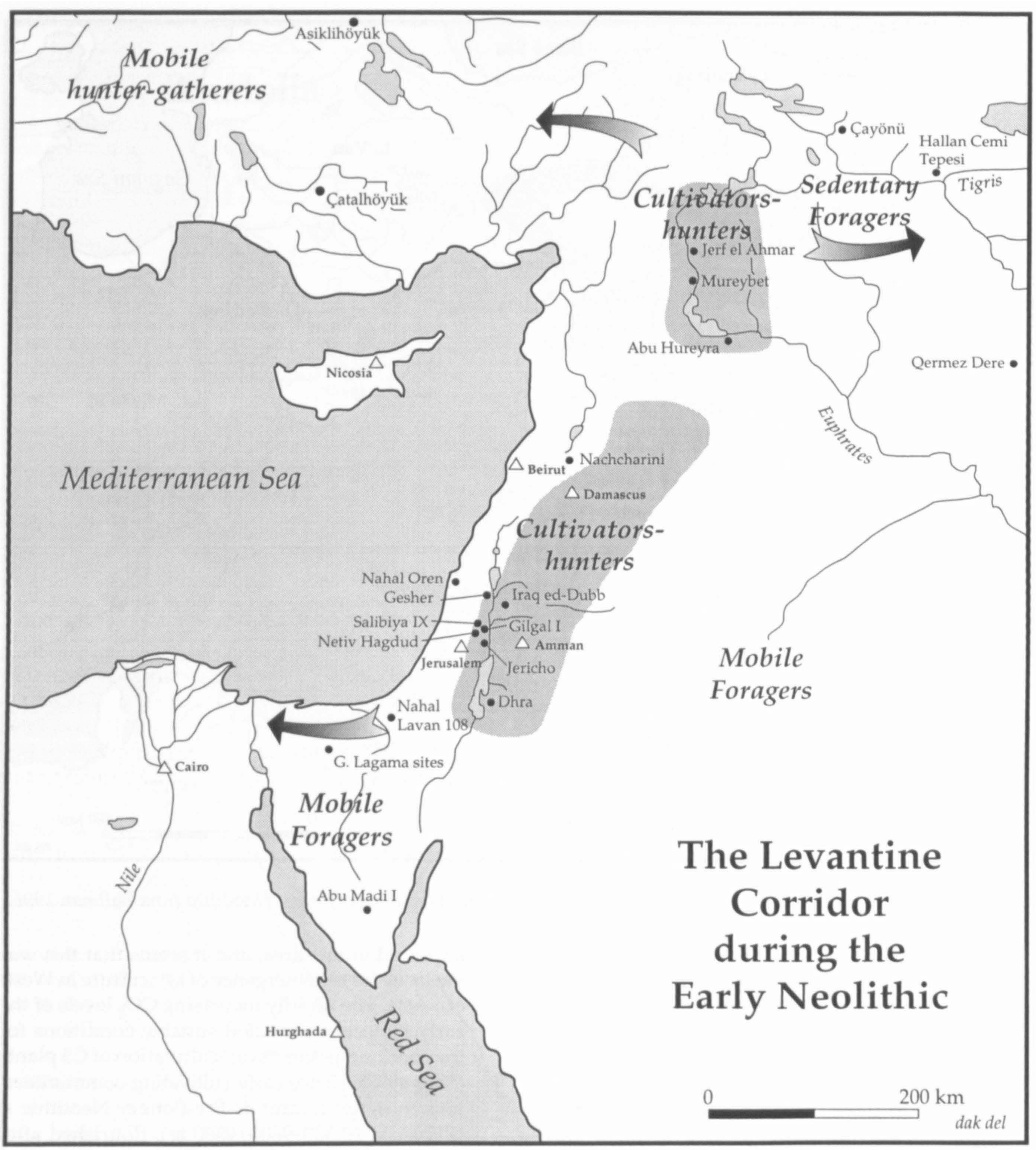

Figure 5. *The Levantine Corridor during the Early Neolithic (10,300–8000* BP*) with arrows marking the direction of colonization and dispersals of 'founder crops'.*

the Early Holocene. These conditions promoted the wider geographic dispersal of the progenitors of the wild cereals which resulted in the contemporary distribution as recorded by Harlan & Zohary (1966; see also Zohary & Hopf 1994).

4. The current archaeobotanical evidence clearly

indicates that the first farmers were cultivators of wild cereals, whether einkorn, wheat, barley or rye (e.g. Hillman *et al.* 1989; Kislev 1989; 1997). These early PPNA communities, from Jerf el Ahmar in the north to Jericho in the south, continued to hunt, trap and gather wild fruits, seeds and leaves. But their staple foods were deliberately cultivated and harvested cereals and legumes (see Hillman & Davies 1990 and Kislev 1997 for detailed discussion). The full appearance of the domesticated forms occurred in the Levantine Corridor in the course of several hundred years, beginning with the Pre-Pottery Neolithic B (PPNB, *c.* 9600/9300–7800/7500 BP; e.g. Hillman & Davies 1990; Kislev 1997). Barley, wheat and rye were domesticated in the area between Jericho and Mureybit. As for einkorn, the genetic evidence suggests that the locus of its first domestication was in southeast Turkey or the northeastern corner of the Levant (Heun *et al.* 1997; Figs. 4–5).

5. Human population growth during the PPNA, documented by an increase in the size of the largest sites from 0.2 to 2.0–3.0 hectares, was coincident with the establishment of cereal cultivation, probably because the latter resulted in predictable supplies of weaning foodstuffs. The increased level of sedentism and greater reliability of food supplies caused both a drop in the age of menarche and a longer period of fertility for the now better-fed women (e.g. Bentley 1996), factors which would also promote population growth. Large villages became viable biological units and reduced or removed the need to travel substantial distances over to find a mate. The sense of territoriality and ownership reached a new level, contributing to the emergence of new and more complex levels of social alliances, supported by re-designed cosmologies (e.g. Cauvin 1994).
6. The domestication of animals (goat, sheep, cattle, pig) took place in PPNB sedentary and semi-sedentary farmer-hunter villages. The domestication of goat and sheep most likely occurred first in the hilly flanks of the Taurus/Zagros (e.g. Legge 1996; Garrard *et al.* 1996; Hole 1996; Smith 1995) where these animals had been hunted for many millennia and local inhabitants were familiar with their behaviour.
7. The inevitable expansion of successful Early Neolithic communities was directed initially northward along the Levantine Corridor and subsequently westward into Anatolia. The introduction of cereal cultivation to the Anatolian basins was rapid (within less than a thousand radiocarbon years) and was achieved by Levantine farmers who also carried their lithic technologies, characterized by the Byblos and Amuq arrowhead types (S. Kozlowski pers. comm.), into the new territories. The introduction of a new subsistence strategy to environments formerly exploited solely by foragers, such as the Konya plain, created a population explosion and motivated demic diffusion, now in a westward direction (Ammerman & Cavalli-Sforza 1984; van Andel & Runnels 1995).
8. The transmission of the new economy eastward to the Zagros foothills, from Kurdistan in the north to Khuzistan in the south, probably occurred without major displacements of human communities. In this area the Late Palaeolithic microlith tradition continued into the Neolithic (Hole 1989; Kozlowski pers. comm.).
9. The Neolithic economy spread through the Mediterranean basin during the period 9000–7000 BP by coastal navigation (Cherry 1990) and by inland movement along the Danube valley (Ammerman & Cavalli-Sforza 1984; Renfrew 1987; Sokal *et al.* 1991). Processes of demic diffusion and acculturation were largely responsible for the 'Neolithization' of Europe.
10. The eastward expansion of Neolithic subsistence systems reached Pakistan within 1500 radiocarbon years. Surprisingly, however, it apparently took about 2000 radiocarbon years to penetrate the Nile valley (by *c.* 6000 BP) although the latter lies within only one week's walk south of the Jordan Valley.

In conclusion, the current archaeological, archaeobotanical and plant genetic evidence confirm that the core area of the Neolithic Revolution lay in the Levantine Corridor — that is to say, the western wing of the Fertile Crescent. The socio-economic changes created new interaction spheres within the region (Bar-Yosef & Belfer-Cohen 1989b; Sherratt 1997). Both the transmission of information along exchange routes and the establishment of new villages by colonists on arable lands marked the move into Europe and the Mediterranean islands. If earlier revolutions had a somewhat similar or at least comparable structure, then we should certainly be able to trace the course of the changes which they involve.

The Middle to Upper Palaeolithic transition, or, Where did the Cro-Magnons come from?

Most scholars who have written about the Middle to Upper Palaeolithic transition consider it to be a revolution (e.g. Gilman 1984; Gamble 1986; Mellars 1989;

1996a,b; White 1989; 1997; Stringer & Gamble 1993; Mithen 1996; Marshack 1972); others (e.g. Clark 1997; Straus 1997) view it as a gradual, regional change.

Here, the view is taken that the Middle to Upper Palaeolithic transition in Western Asia and Europe was a true technological and cultural revolution. The first and principal lesson to be learned from the study of the Neolithic Revolution is that this too began in a core area. If no specific region of Europe is considered to be that core area, then it follows that when we compare archaeological remains of European Neanderthals with those of the Cro-Magnons, we are not studying a revolution that occurred *in situ*. Such a comparison tells us about differences and similarities between two populations, but not about the causes and early phases of this revolution. Cro-Magnons and Neandertals came to inhabit the same regions in Europe as the result of colonization by the former group. We have no clear idea where this revolution took place, although certain observations point to East Africa (Ambrose 1998) while others suggest the Levant (e.g. Sherratt 1997). The best documented and richest archaeological records are in western Europe, but even with the fragmentary nature of the archaeological records from other regions and the incomplete sequence of human fossils, a reasonably clear picture emerges (e.g. Clark 1992; Deacon 1992; Bar-Yosef 1994; Foley & Mirazón Lahr 1997; van Peer 1998).

There is little doubt today that the emergence of Anatomically Modern Humans (AMH) took place some 300,000–100,000 years ago in sub-Saharan Africa (e.g. Ruvolo 1996; 1997; Harpending *et al.* 1998; Cavalli-Sforza *et al.* 1993; Relethford 1995; Goldstein *et al.* 1995) and was followed by dispersals into Eurasia (Fig. 6). Early Modern Humans seem to have inhabited parts of Asia by 110,000–90,000 years ago (the Skhul-Qafzeh group, also known as 'Proto-Cro-Magnons') and to have reached Australia by about 60,000 BP (papers in Akazawa *et al.* 1998; Roberts *et al.* 1990). AMH are present in North Africa in a Middle Palaeolithic (Mousterian) context in Gebel Irhoud cave during Isotope Stage 6, which ends *c.* 130,000 BP (e.g. Hublin 1992), in Haua Fteah (McBurney 1967) and in the Aterian deposits at Dar es Sultan and Mugharet el 'Aliya (Klein 1989; Minugh-Purvis 1993). The Aterian, derived technologically and typologically from the local Mousterian, is dated 160,000–70,000 BP in Egypt and as late as 35/30,000 BP in the Maghreb (Wendorf *et al.* 1993; Tillet 1989; Wengler 1997).

It is generally agreed now that the 'archaic' to 'modern' morphological changes had taken place *long before the transition* from the Middle to the Upper Palaeolithic (currently dated to *c.* 50,000–40,000 years ago in East Africa, the Near East and Europe), and that this is a cultural change. There is evidence (albeit from a single sample) that Neanderthals differed genetically from *Homo sapiens* (Krings *et al.* 1997). What we have, therefore is a pattern of biological change not correlating with cultural change. There are of course other opinions, such as Klein's suggestion that the modern capacity for culture expressed in Upper Palaeolithic remains (beads, art objects, sophisticated bone and antler industries, etc.) can only be explained by a neurological change that occurred some 50,000 years ago (Klein 1995). As I have shown, comparison with the Neolithic revolution suggests that invoking such a neurological change is not necessary.

Whether one supports the 'out of Africa' or 'multi-regional evolution' model for the biological change, there is a general level of agreement on the existence of a cultural change that is referred to as the Middle to Upper Palaeolithic, or in sub-Saharan Africa as the Middle to Late Stone Age transition. Some scholars see this cultural transition as an event that took place independently in each region through local adaption to changing environmental conditions or an increase or decrease in population size. The view taken here, however, is that the cultural change occurred in a core area and was then transmitted by colonizers to other regions where it became established. If this is correct, we need to locate the core area where the process began and from which it spread. Here the Middle/Upper Palaeolithic Revolution can be profitably studied by the same approach employed for the Neolithic Revolution. The first step should be similar to that taken by Braidwood in the 1940s — creation of a 'gap chart' (Young *et al.* 1983) which will indicate where we should look for the missing information. The following observations may be considered:

1. Who was responsible for the transition from the Middle to the Upper Palaeolithic? Does this transition reflect the emergence of modern behaviour? Does it reflect the appearance of language as we know it today? Could Neanderthals produce the same kinds of stone tools, beads and bone tools as the Cro-Magnons? Does the evidence from the few preserved burials demonstrate cultural differences between Neanderthals and early modern humans, even where both were producers of various Mousterian industries?

We start by assuming that this archaeological transition is cultural, and was not produced by a

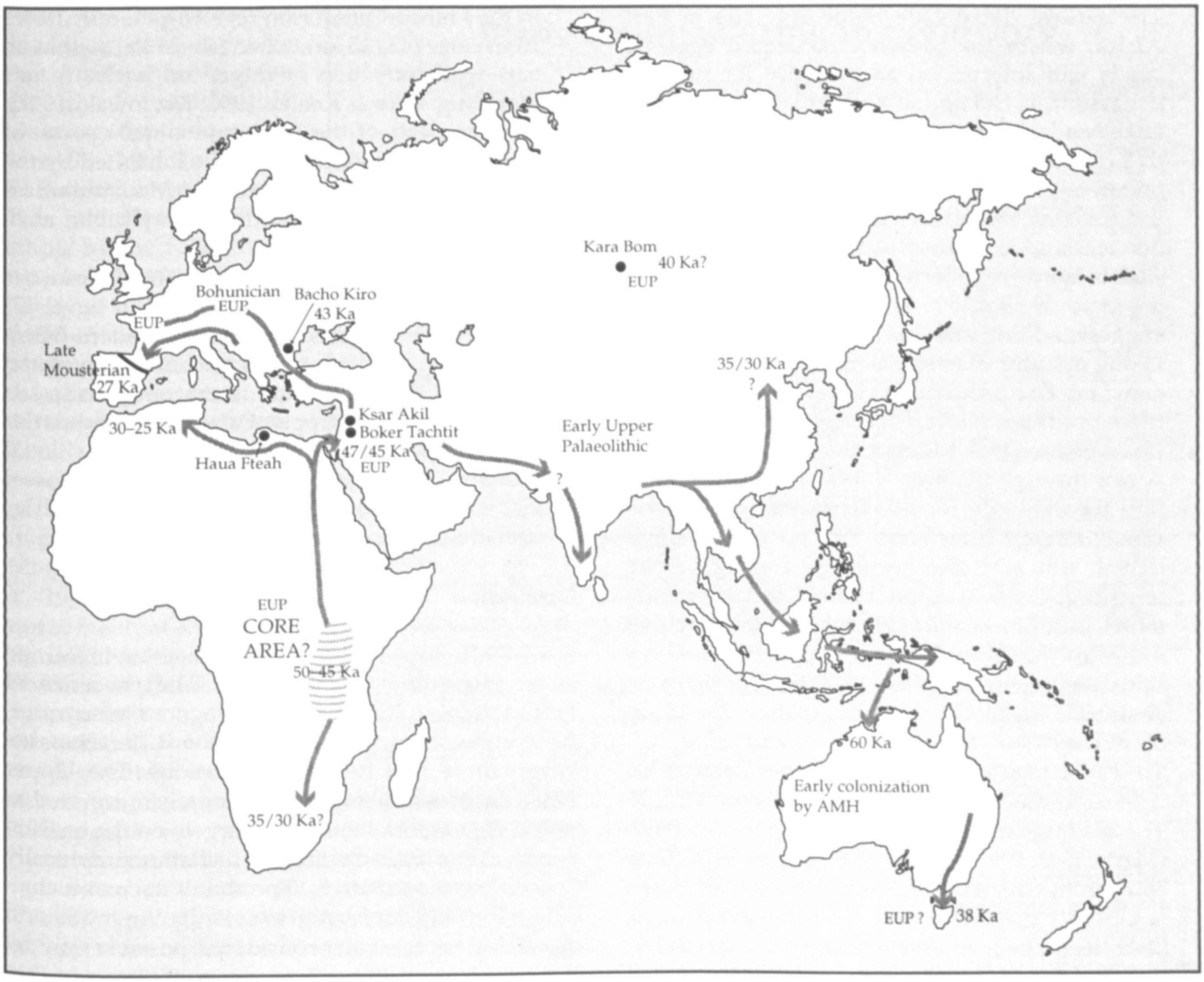

Figure 6. *The routes of dispersals of the Upper Palaeolithic revolution with a potential core area in East Africa.*

population that was biologically different from and therefore inherently smarter than its contemporaries. Instead, we suggest that the population responsible for the transition succeeded in improving its technical skills, was able to achieve better returns on hunting and gathering forays, and had reached higher fertility and infant survival rates (e.g. Bentley *et al.* 1993; Bentley 1996). This population consequently re-organized its social structure and created a better means of communication. Such a population, as history demonstrates, would tend to expand rapidly. Employing this approach eliminates the need to view phylogenetic factors as the sole essential triggers for change at a particular time.

2. The fact that cultural manifestions of the Early Upper Palaeolithic (EUP) appeared only around 50,000–45,000 years ago in a certain core area and expanded from there indicates that, as with the Neolithic, not all the populations of AMH took part in this revolution. There is general agreement that AMH had begun to spread within Africa and into Eurasia at least since Isotope Stage 6, some 200,000 years ago. Examples include the Qafzeh-Skhul people, who produced a Mousterian industry, buried their dead, used red ochre and collected marine shells. Likewise, as noted previously, human remains of AMH in North Africa are associated with Mousterian and Aterian industries. Furthermore, although Australia was colonized presumably by AMH some 60,000 years ago, the earliest human fossils are dated to *c.* 30 ka.

3. The earliest dated Late Stone Age site in East Africa, where the presence of ostrich eggshell beads was interpreted as evidence for modern behaviour, is Enkapune Ya Muto in Kenya, near Lake Naivasha (Ambrose 1998). The earliest layer that contains an Upper Palaeolithic assemblage is tentatively dated to around 50,000 years ago (on the basis of obsidian hydration dates, radiocarbon readings and rate of sedimentation). The eggshell beads were collected from a younger deposit, dated to 39,900±1600 BP (Pta-4889F2). Ambrose suggests adding another 3500 years to this date, taking account of evidence for increased cosmogenic nuclide production (Laj *et al.* 1996). Hence these beads are the earliest recorded in Africa.
4. If we believe that Modern humans came out of Africa through the Nile Valley, then we need to find the evidence for this dispersal route. A recent summary (van Peer 1998) surveys the evidence, but unfortunately the timing of the transition is not well-established in radiometric terms. In addition, the evidence from the Maghreb indicates that the Middle to Upper Palaeolithic transition occurred after 40,000 BP, perhaps at about 35,000–30,000 BP (interpolation based on McBurney 1967; Tillet 1989; Wengler 1997).
5. The earliest radiocarbon-dated Upper Palaeolithic context in the Levant is Level 1 at Boker Tachtit. The readings indicate an age of 47,000–46,000 BP (Marks 1983; 1993). The assemblage, made of blade cores from which Levallois points were obtained, is Upper Palaeolithic and not Mousterian in its basic technological and typological characteristics. The Levallois points preserve bi-directional scars of previous blade extraction and thus differ entirely from the Late Mousterian Levallois points in the Kebara (Meignen & Bar-Yosef 1991) or Amud cave (Hovers *et al.* 1995). A different industry, unfortunately not well-dated, was reported from a cluster of sites in Lebanon including Ksar Akil (Copeland 1975; Ohnuma 1988; Ohnuma & Bergman 1990). These assemblages are characterized by a high flake component with a dominance of Upper Palaeolithic stone tools, including chamfered pieces. While different from Boker Tachtit level 1, they are of broadly comparable technological status. Worth mentioning is that the same industry, with chamfered pieces, called the early Dabban (dated to *c.* 35–30 ka), characterizes the early Upper Palaeolithic at Haua Fteah (McBurney 1967).
6. In Europe, the trajectory of available radiocarbon dates (all uncalibrated), from Bacho-Kiro (Bulgaria) to the Franco-Cantabrian region, generally flows from early (45/43 ka) to late (40–38 ka) so that an east–west transition or migration is clearly implied (e.g. Otte & Keeley 1990; Kozlowski 1992). At least parts of the Iberian peninsula south of the Ebro Valley continued to be inhabited by the Neanderthals, manufacturers of Mousterian assemblages, until at least till 27 ka (Hublin *et al.* 1995).
7. In the Levant, the earliest human fossils from the Upper Palaeolithic layers of Ksar Akil (level 17) and Qafzeh are considered to be modern "Cro-Magnons". All these fossils are tentatively dated to 35,000–28,000 BP. There are no human fossils from the earliest Upper Palaeolithic industries (the Emiran, or as it is also called the Transitional Industry), a situation that parallels the general lack of skeletal material from the earliest Aurignacian in Europe (Gambier 1989).

Discussion

The Middle/Upper Palaeolithic transition in Europe is an intriguing phenomenon. The presence of Neanderthals followed by Cro-Magnons raises questions concerning the nature of the differences between these two human populations. The Upper Palaeolithic assemblages and sites are interpreted as reflecting modern behaviour, largely on the basis of comparisons with the lifestyles of ethnographically known hunter-gatherers. The ability to cross a challenging ecological barrier to colonize Australia and the Americas has been considered possible only by humans like us. One common explanation is that Cro-Magnons were the first to fully master language (Lieberman 1989; Whallon 1989). Language enabled major necessary changes in social organization without which the colonization of the northern latitudes could not have been accomplished. This contention, however, is the subject of vigorous criticism by linguists, brain scientists, and behaviourists who try to decipher the evolution of human language and cognition (Mellars & Gibson 1996 and papers therein). All these researchers necessarily employ archaeological information to test their models (e.g. Donald 1991; Mellars & Gibson 1996; Deacon 1997; Lieberman 1997; Mithen 1996; 1997). There seems a growing agreement that humans have used language at least since 400–300 ka (Kay *et al.* 1998). This is supported in part by the fossil evidence such as the discovery of the modern-looking hyoid bone at Kebara (Arensburg *et al.* 1990), though such finds are rare.

In contrast to previous suggestions (Binford

1989), the archaeological evidence demonstrates that humans could have displayed considerable planning depth long before the Middle/Upper Palaeolithic transition. This is evidenced for example by the Schöningen wooden throwing-spears (Thieme 1997) that are dated to *c.* 400 ka. Similar planning ability is also recorded by our better understanding of the operational sequences in the production of blanks from nodules of raw material (e.g. Boëda *et al.* 1990; Meignen 1993; Geneste *et al.* 1997; Schlanger 1996), not to mention some of the finished tools themselves. Studies of these *chaînes opératoires* have demonstrated that the level of forethought in core reduction strategies among the Eurasian Middle Palaeolithic people was no less complex than that shown by producers of blades from prismatic cores.

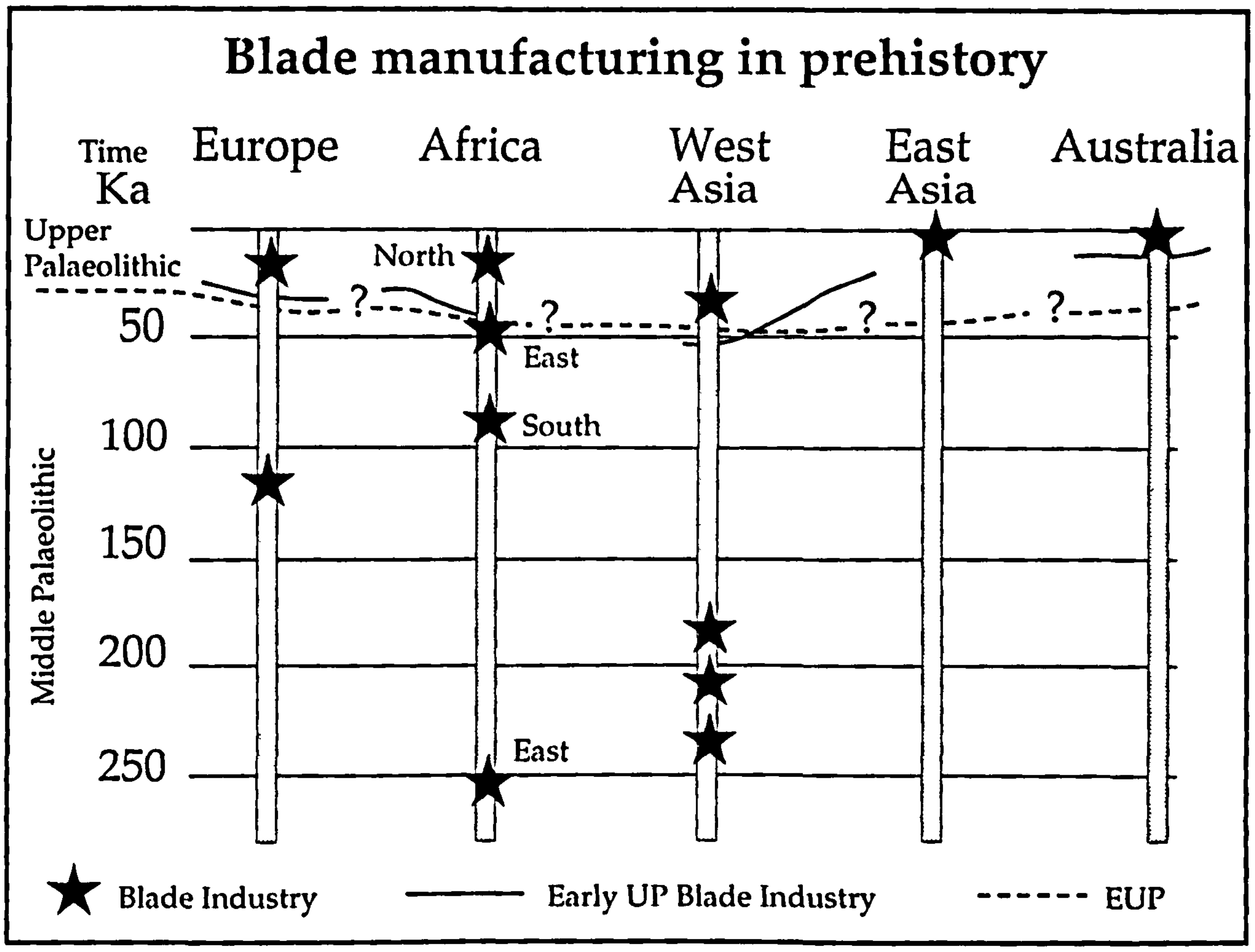

Figure 7. *Early and late appearances of blade manufacturing in various parts of the Old World. Note that the earliest manifestations of the Upper Palaeolithic revolution preceded the blade production in some areas.*

Some of the scraper types distinguished in Bordes' typology were argued by Dibble (e.g. 1995 and previous references therein) to form a continuum of reduction. In my view the resharpening of artefacts by certain Mousterian groups, and others, such as the Yabrudian, occurred regardless of the need to conserve raw material and shows a capacity for tactical planning. Several Mousterian industries are also characterized by the presence of types (e.g. small bifaces, flat foliate points, or tanged tools), which seem to reflect the existence of well-defined designs. In addition, numerous cases of curation in Middle Palaeolithic contexts do not differ from Upper Palaeolithic examples, and curation over long distance is also considered a marker of modern behaviour. In South Africa, for example, the production of Howieson's Poort backed pieces from non-local raw material indicates exchange across a wide region some 70,000 years ago (Deacon 1992). A somewhat similar example can be cited from Germany, where raw material was brought from distances of up to 100 km by Mousterians (Conard & Adler 1997) and rarely more than 200 km (Féblot-Augustins 1997). In general, however, longer distances are common for the movement of raw material among Upper Palaeolithic cultural entities.

An important issue is the production of blades which have so often been considered, again on the basis of the European evidence, as the marker of the Upper Palaeolithic. The earliest occurrences of industries with abundant blades are, however, dated to around 250,000 BP in East Africa, 250,000–150,000 BP in the Levant and possibly 200,000–150,000 in Transcaucasia (e.g. McBurney 1967; McBrearty *et al.* 1996; Jelinek 1990; Meignen 1994; 1995; Liubin 1977). Western Europe itself is in fact rich in early blade industries mostly from Isotope Stage 5. Many Middle Palaeolithic assemblages, containing abundant blades, are known from Germany (Conard 1990), northern France (Meignen 1994; Révillion & Cliquet 1994), and Belgium (Otte 1994). Methods employed in blade production ranged from uni- and bi-directional recurrent Levallois at Biache-Saint-Vaast (Tuffreau & Sommé 1988) to the more typical Upper Palaeolithic methods involving prismatic cores (Otte 1994). No blade industries are known from the period of full glacial conditions in Europe, however, and it seems that the techniques of Upper Palaeolithic blade manufacture do not represent a lasting technological tradition from the earlier manifestations. In any event, the existence of pre-Upper Palaeolithic blade assemblages indicates that both Neanderthal and AMH populations mastered this technology prior to 50,000 BP.

In Europe and the Near East the differences are in the secondary trimming and the shaping of 'tools' from blanks. While Middle Palaeolithic forms remain the same for longer periods the Upper Palaeolithic industries are characterized by rapid turn-over of shapes or types in these regions.

When other categories of archaeological evidence are taken into account it is not surprising to find that most researchers conclude that the cognitive abilities of Upper Palaeolithic modern humans in Europe, and especially in the Franco-Cantabrian region, differed from those of the makers of Mousterian or other Middle Palaeolithic industries. A supposed surge of self-awareness is expressed in the greatly expanded industries of bone, antler and ivory, the range of beads, pendants and marine shells as body decorations, and the various forms of mobile and rock art (Mellars 1989; 1996a; White 1997). The proliferation of these traits undoubtedly stands in contrast to previous Middle Palaeolithic assemblages, with only a few 'art' objects (e.g. Marshack 1997 and references therein). It should be stressed, however, that the cultural sequence in Western Europe is unusual within the Upper Palaeolithic. We need to ask why and how the cultural trajectory of this Upper Palaeolithic took a different course from its contemporaries in the Near East, Africa, eastern Asia or Tasmania. The assumption that only those 'art' manifestations that survived, correctly interpreted as symbolic expressions, constitute direct evidence for language (Davidson 1997) indicates a biased approach that avoids or fails to perceive the basic question: why is it geographically limited? If there are social determinants common to all foragers across the world, then we should expect to find similar symbolic behaviours in a variety of landscapes.

The Middle to Upper Palaeolithic transition in the Near East and Europe can be explained as the introduction of new technologies. These include techniques for food acquisition, such as spear throwers, new forms of projectile heads, and even archery, perhaps basketry, as well as new tools for food preparation such as grinding stones (de Beaune 1989; Wright 1991). New trapping and storing techniques may have become available, although the evidence for this is still meagre (Soffer 1989b). Stable food provisioning in seasons of stress resulted in population increase as newborns had a better chance of surviving and reaching adulthood. A slight increase in life expectancy secured the survival of older members of the group, thus extending the 'living memory' of the group. Over time this would lead to better monitoring of the environment and of more distant regions. Long-range networks of social alliances (Gamble 1982) were developed to overcome seasonal or annual periods of economic stress. With such a dynamic feedback chain of socio-economic changes the formation of new interaction spheres was a natural outcome. Communication systems were improved, probably involving not only linguistic abilities but methods and techniques of communication which enabled groups to move across large distances without losing the personal contacts essential for keeping and maintaining mating systems. These are best expressed in the movement of objects and raw materials over long distances (Roebroeks *et al.* 1988). The identification of particular human social groups is also reflected in specialized lithic artefacts (Otte & Keeley 1990) and body decorations (White 1989).

The movement of the Cro-Magnons across Europe followed several routes. One went along the Danube valley, and possibly through the central European plains, into temperate Europe; the other was a southern, Mediterranean route. Encounters with the Neandertals resulted in replacement, or either the formation of reciprocal cultural contacts or unidirectional acculturations. Châtelperronian and Uluzzian are now often perceived as the results of such encounters and demonstrate the ability of Neanderthals to make blades of Upper Palaeolithic type, together with bone and antler objects and beads. The fact that they did not do so everywhere, and not until the AMH expanded into Europe, may indicate that the maintenance of old traditions was a particularly strong element in their social structure (but see the argument on Neanderthal acculturation by d'Errico *et al.* 1998).

In sum, one can very clearly see dramatic changes, similar to those at the origin of agriculture, taking place within a single human population. It can plausibly be argued that there is no need to invoke a marked biological threshold for the onset of the Upper Palaeolithic. Unlike the Neolithic situation, we do here have in the European world two different human populations, perhaps different species, but the key point is that the cultural transition does not take place when one of these species first appears. Careful studies of the archaeology of the immediate AMH ancestors of Upper Palaeolithic humans (or the Cro-Magnons) in their original homeland or core area will probably reveal the technical and organizational pre-adaptations that made a successful population change its lifeways — a change for which the direct evidence is the kind of archaeological residues we call 'Early Upper Palaeolithic'. Despite the capabilities of Middle Palaeolithic humans, Upper Palaeolithic populations within the 30 ka following their appearance did technologically much better, most of the time, in every ecological context. A striking illustration is successful survival in subarctic conditions, through numerous technological innovations (Soffer 1989b), and their success in colonizing the Americas.

The development of tangible expressions of self-awareness and of changing intra- and inter-societal, as well as societal/environmental relationships, is reflected in their body decorations, decorated objects, portable art, rock art, and specially designed tools. These were created by populations when and where the need for such expressions arose (Belfer-Cohen 1988). Not all groups of foragers were in the same situation, had the same social structure or the same needs. Hunting and gathering groups have long differed in their responses to regional carrying capacities, through their particular technologies and social organization. The continuous success of one group could have caused the decline of a neighbouring group. Demographic modelling by Zubrow (1989) indicates how quickly a less successful population, in this case the Neanderthals, may disappear. But this did not happen at the same pace everywhere. In Iberia we now know that the Neanderthals survived for at least another 13,000–15,000 years after the first arrival of the Cro-Magnons in that same general area. Similar interpretations concerning the relationships between incoming and local populations would doubtless apply to the Mesolithic/Neolithic transition in most of Eurasia, but discussion of this issue is beyond the scope of this article.

Concluding remarks

The core area where the transition to agricultural subsistence began is characterized by a high degree of topographical and phytological variability in a relatively small geographical area. Resources, especially plant foods, are predictable, highly accessible and reliable.

A summary of the old ways of life would indicate a low degree of mobility especially in lusher areas (perhaps even semi-sedentism), coupled with seasonal exploitation of ecotonal resources. Groups were able to sustain themselves in steppic and semi-desertic conditions by keeping total population at low numbers with relatively high mobility. High altitude exploitation was left to special task groups.

Some of these same factors are relevant when we assess 'old ways of life' at the time of the Middle to Upper Palaeolithic transition. The Middle Palaeolithic is characterized by a low degree of regionalization — the same or similar lithic technologies prevail over large areas, such as the entire Levant.

Only a few occurrences of symbolic behaviour are encountered in Middle Palaeolithic deposits of Western Asia; they include burials (several with grave offerings), the use of red ochre and rare marine shells. Sub-Saharan Africa seems to have been richer, with examples of barbed points in Zaire (Brooks *et al.* 1995), bone objects in Howieson's Poort in south Africa and the early appearance of ostrich eggshell beads (Ambrose 1998). There were low levels of overall fertility in the temperate zone but possibly higher ones in subtropical latitudes.

In each case the revolution is technical with immediate socio-economic implications. The Neolithic is driven by environmental deterioration during the Younger Dryas; it is still not known what precisely triggered the Upper Palaeolithic revolution.

With the passage of time, the socio-economic effects of each revolution became permanent features of the new cultural pattern, whether early Upper Palaeolithic or early Neolithic. The immediate results would be new planning and scheduling of subsistence strategies, increased rates of survival of newborns and prolonged survival of the elders in the group. This would bring not only a population increase but selective advantages in long-term monitoring of the environments treasured in the prolonged 'living memory' of the group. It would also enable the formation of long-distance social alliances in the Early Upper Palaeolithic surpassing those of the Middle Palaeolithic, and long-distance exchange and trade relations in the Neolithic.

The practical results of the revolution in each case were immensely important, both immediately and in the longer term. The following are merely examples: (a) improved subsistence strategies with new technologies/techniques such as spear-throwers and the earliest archery in the Early Upper Palaeolithic, and improved archery in the Neolithic; (b) improved clothing, especially needed in northern latitudes in the Early Upper Palaeolithic and the use of linen with other traditional materials in the Neolithic; (c) improved gathering and transport devices including baskets, sledges, and the first appearance of storage facilities; (d) the first use of grinding stones for food processing in the Upper Palaeolithic and the introduction of different types of grinding stones for various activities in the Neolithic; (e) increase in the number of exploited raw materials or the frequency of their use in the Early Upper Palaeolithic (i.e. antlers and bones, special hard rocks), and long-distance procurement of raw materials, curation of artefacts, and import of exotic raw materials (such as obsidian) in the Neolithic; (f) improved systems of long-distance, intergroup communication in the Early Upper Palaeolithic (drums?) that enabled small groups to move over large areas and keep in contact with others. This may have included the first referential and even numerical systems (Marshack 1972; 1997) in which symbolic notations and paintings serve as aids for the 'living memory' of the group (or groups) and for shamanistic activities aimed at enhancing social cohesion (when members might be dispersed over extensive territories).

For these successful populations, the net result of these and other changes would be an expansion of the kind which we can trace in the archaeological record of both the Middle/Upper Palaeolithic and Neolithic Revolutions.

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